Understanding the spatial distribution of avalanche fatalities in Utah, 2010 -2020

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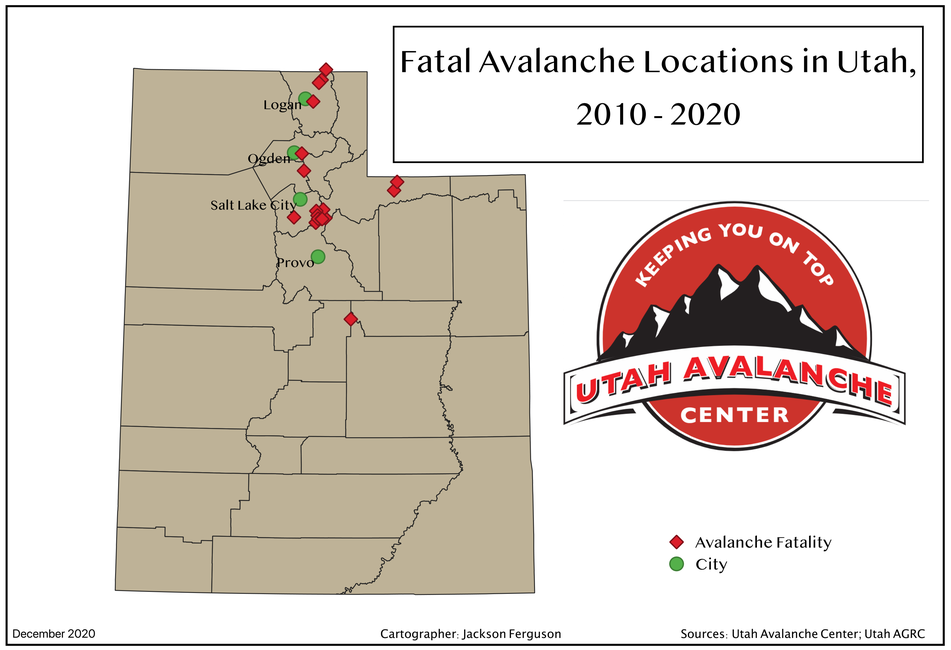
Introduction

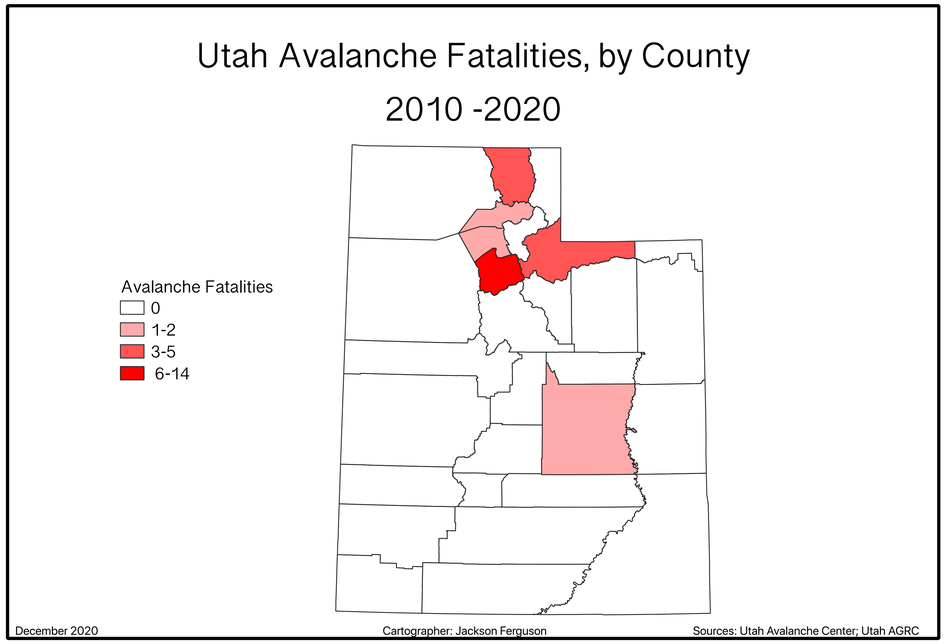
Avalanches are defined simply as “a mass of snow sliding, tumbling, or flowing down an inclined surface” by the American Avalanche Association. While they can vary greatly in size and type, avalanches pose a serious threat to those traveling in the backcountry. According to National Geographic, “humans trigger 90 percent of avalanche disasters, with as many as 40 deaths in North America each year.” (2019) Backcountry enthusiasts — skiers, snowmobilers, climbers, and other outdoorsman that venture into wild, unmanaged mountain terrain — can mitigate the risk of avalanches by equipping themselves with the knowledge necessary to keep them safe in the wild. The purpose of this project is to continue the work of building knowledge about avalanches by creating a database that maps avalanche fatalities in Utah. The primary vector layer is be a point layer that marks the precise location of avalanche fatalities, which has the potential to capture spatial trends in such occurrences. These findings will be bolstered with a statistical analysis.

Data and Methods

All avalanche data used in this mapping and subsequent statistical analysis was retrieved from the Utah Avalanche Center (UAC), a nonprofit dedicated to promoting avalanche safety. All other vector layers, such as the Utah county boundaries and city names, were retrieved from the Utah Automated Geographic Reference Center (Utah AGRC). All vector layers were reprojected into the NAD83/UTM12N CRS. In order to create the point vector layer identifying the locations of avalanche fatalities in the last decade, data (including coordinate data) was downloaded from the UAC. This data was filtered and organized in Excel to only include avalanches that were accidental, human-triggered avalanches (excluding both naturally occurring and purposefully triggered avalanches). This data was then imported into QGIS as a point vector layer, using the longitude and latitude columns as x and y coordinate reference points. In order to calculate the spatial distribution of avalanche fatalities by county, the “Count points in polygon” tool in QGIS was used. The reference polygons were Utah counties and the points in question were from the newly created avalanche fatality location. The output of this function was a new vector layer containing both Utah county information as well as the number of avalanche fatalities in each county from 2010 to 2020. In order for the data to be interpretable, a graduated (sequential) color scheme was used to compare the number of avalanche fatalities in each county. To further develop this spatial analysis, descriptive statistics and pie charts were used to characterize the percentage of avalanches and fatal avalanches that occur in each region of Utah. According to the UAC, there are 10 such regions, each named by a nearby city: the Abajos region, the Logan region, the Moab region, the Ogden region, the Provo region, the Salt Lake region, southeast Idaho region which is excluded from this particular analysis, the Skyline region, the Southwest region, and the Uintas region.



Map 1. Locations of fatal avalanches



Map 2. Avalanche fatalities by county

Works Cited

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Results

Map 1, containing the point vector layer that identifies the precise location of all fatal avalanches, shows a clear spatial distribution of avalanche fatalities. Of all the fatal human-triggered avalanche accidents in Utah between 2010 and 2020, the vast majority occurred in the northern, central portion of the state. Furthermore, there is a large cluster of fatalities near Salt Lake City and Provo.

Map 2, depicting the number of accidental, human-triggered avalanche fatalities in Utah by county, takes this analysis one step further. It is abundantly clear that the vast majority of avalanche fatalities happen not only in north central Utah, but specifically in one county — the Salt Lake county. Figure 1 is a pie chart showing the percentage breakdown of all accidental human-triggered avalanches (fatal or not) between 2010 and 2020, while Figure 2 only shows this breakdown for avalanches resulting in fatalities. Figure 1 clearly shows that the vast majority of Utah’s reported avalanche accidents occur in the Salt Lake region, accounting for around 64% of all reported avalanches. The next two regions with the highest percentage of reported avalanche accidents are Uintas at 11% and Logan at 10%. Of more interest to this project, however, is the discrepancies between the findings of Figure 1 and Figure 2. Although most avalanche fatalities are in the Salt Lake region, the percentage of fatal avalanches in the region is much smaller than the total percentage of avalanches. That is to say, while 64% of Utah’s avalanche accidents are reported in Salt Lake, the region only accounts for 38% of fatal avalanches. Conversely, the regions of Moab, Ogden, Provo, Skyline, Southwest, and Uintas all see increases in this measure.

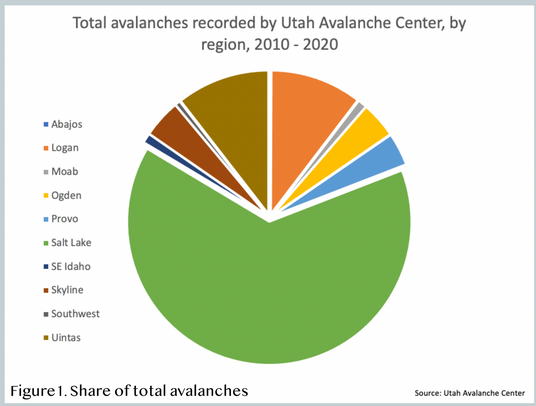

Figure 1. Share of total avalanches

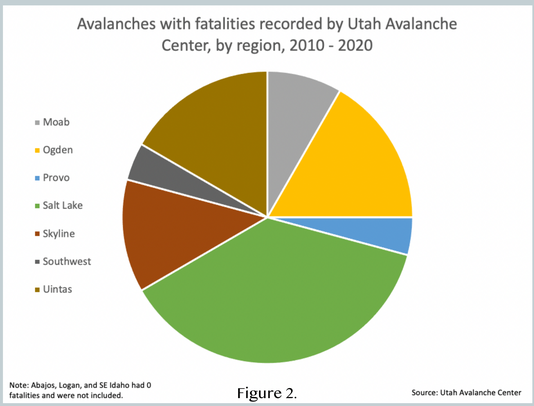

Figure 2.

Discussion and Conclusion

Both Map 1 and Map 2 confirm that there is a strong spatial pattern to avalanche fatalities in Utah. This cannot simply be attributed to available terrain — while it is true that the central northern region of Utah is quite mountainous, there are mountain ranges throughout the state. A likely explanation, then, for why there are higher numbers of fatalities in this region is simply population density — Salt Lake County is the most populous (and most densely populated) county in all of Utah by some margin. (World Population Review, 2020) Additionally, Salt Lake City and surrounding ski areas are popular tourist destinations that could be responsible for placing inexperienced newcomers in unknown avalanche terrain.

Figures 1 and 2 bolster this analysis by exposing the complexity of avalanche fatalities in Utah. While Salt Lake has the largest share of all accidental avalanches in this study’s time period, it has a comparatively small share of the fatal avalanche accidents. This seems to suggest that the Salt Lake county is doing something more effective than other counties to keep people safe in the backcountry. This could be explained by proximity to major cities, and therefore to efficient medical rescue teams, but this is an area that needs more research.